2017 ANNUAL FLOW SUMMARY

During 2017, flow in the Platte River remained high during the winter and early spring. Late spring and early summer saw a moderate peak flow of 4,810 cubic feet per second (cfs) at the USGS gage at Grand Island, Nebraska. This corresponds to a peak flow recurrence interval of roughly 1.5 years. Flow remained in the average to slightly above average range for the remainder of the year, resulting in an annual flow volume of 1,147,328 acre-feet (AF) at Grand Island. This volume barely exceeded the Program's annual hydrologic condition wet year threshold of 1,140,256 AF, and thus 2017 was classified as a wet year. **Figure 1** shows the annual hydrograph in 2017.

2017 presents an interesting example of a year where the peak flow is relatively low while the annual flow volume was comparatively high: 63% of peak flows observed at Grand Island from 1942 t0 2017 have exceeded the 2017 peak while only 36% of annual flow volumes at Grand Island from 1942-2017 exceeded the 2017 annual volume.

The real time hydrologic condition during 2017 remained NORMAL for most of the year, with the condition shifting to WET in June and to DRY in August and September. River flows were in excess of FWS target flows for half the year (49%) and were below target flows the other half (51%). This amounted to a total annual volumetric deficit to target flows of 263,274 AF (based on real time hydrologic condition designations). FWS target flows based on real time hydrologic conditions are shown in **Figure 1**.

The US Fish and Wildlife Service (FWS) made three flow releases from the Lake McConaughy Environmental Account (EA) in the early spring for channel maintenance and wet meadow recharge, one in the early summer for channel maintenance pulse flow, and one late summer to support aquatic communities. The total volume of each release is shown in **Figure 2** and the corresponding contribution to flow at Grand Island is shown in **Figure 1**. These releases provided 123,305 AF of additional flow in the Platte River at Grand Island and served to reduce deficits to target flows by 101,729 AF. To accomplish these releases, 142,400 AF was released from the EA, corresponding approximately 150% of the accruals to the EA in 2017. **Figure 2** also shows the changes to the EA volume over the course of 2017 as it gains water from storable natural inflows and water transfers and looses water to releases, evaporation, and seepage.

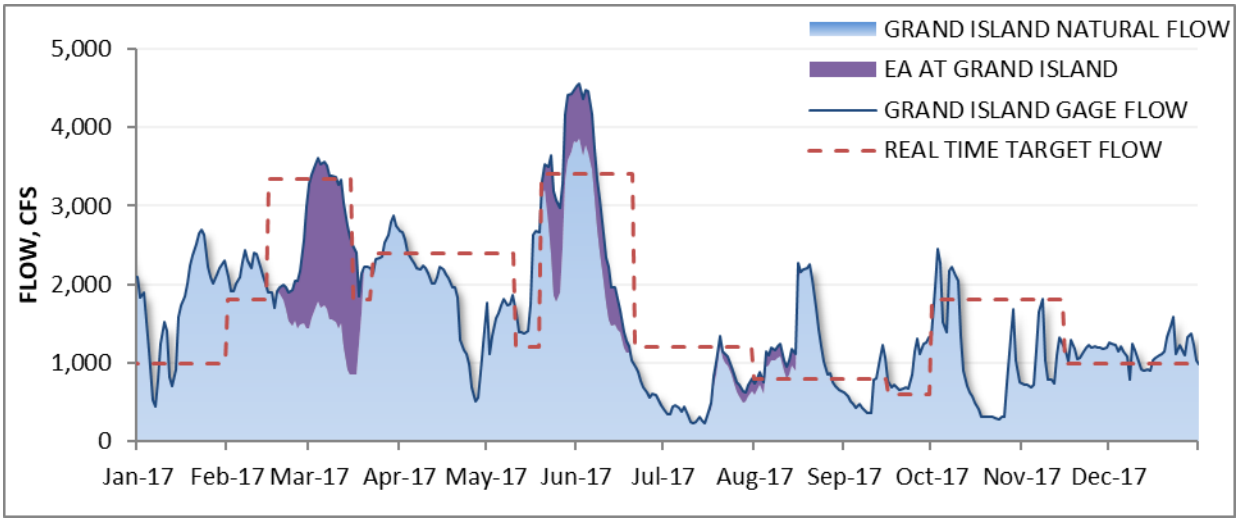


Figure 1. 2017 Grand Island flow and USFWS Target flows.

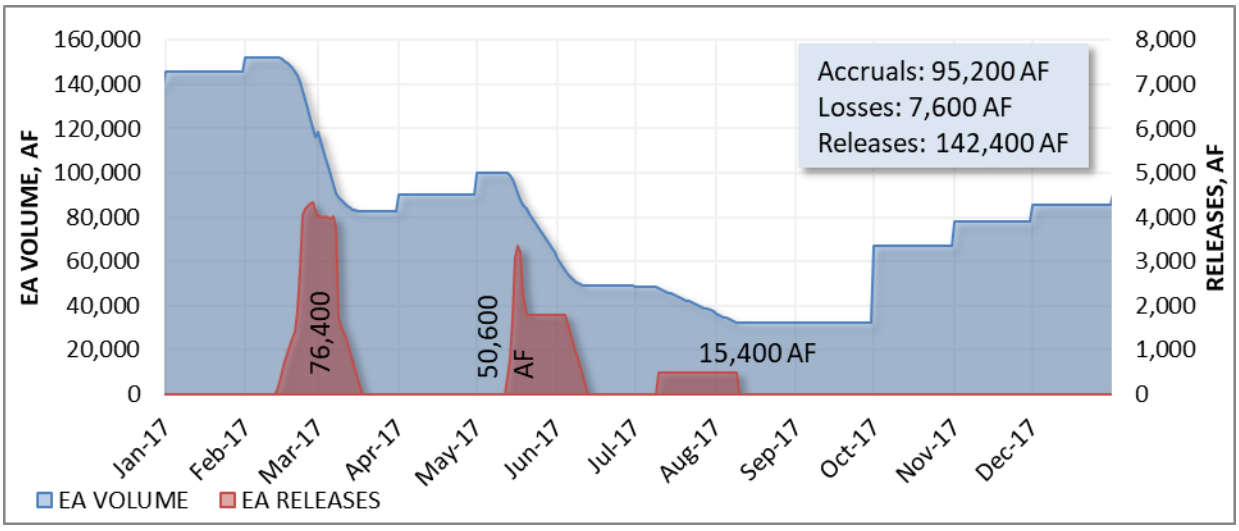


Figure 2. 2017 Lake McConaughy EA volumes and releases.

PRRIP Water Update

As part of the original water objective, the Program was tasked with reducing shortages to target flows defined by the U.S. Fish and Wildlife Service (USFWS) by 130,000 to 150,000 acre-feet per year (AFY) by the end of the 13-year First Increment (2007-2019). Despite much progress this task has proved to be more difficult than originally anticipated due to several political, technical and economic factors. To ensure the original goal is met, the signatories of the Program agreed to a 13-year First Increment Extension (2020-2032) where, in addition to other land and science objectives, the Program "will invest the resources available to achieve at least 120,000 AF in annual reductions to target flow shortages as quickly as possible… and will also invest in the science necessary to determine if the additional 10,000 AF is justified." This white paper will highlight the Program's water project portfolio as it relates to achieving the water objective of the First Increment/Extension.

Initial State Projects and WAP Objective:

Three initial state projects provide a combined yield of 80,000 AFY towards the water objective. These projects are the Tamarack I Project in Colorado, the Pathfinder Modification Project Environmental Account in Wyoming, and the Environmental Account in Lake McConaughy in Nebraska. Per the Program document, the remaining 50,000 to 70,000 AFY of yield is to be contributed through implementation of the Program's Water Action Plan (WAP). Projects implemented via the WAP are valued (i.e., "scored") based on their ability to provide reductions to target flow shortages. The score of a project is considered the yield when referencing reductions to target flow shortages and is determined by modeling operations using 1947 to 1994 hydrology.

WAP Implementation:

Implementation of the WAP has been ongoing since 2007. To date, the Program has secured 9,470 AFY of water via operational projects with an approved score (see below).

Project	Score [AFY]	Period of Operation
No-Cost Net Controllable Conserved Water	260	2007-2018
Phelps County Canal Groundwater Recharge	2,700	2011-2018
Pathfinder Municipal Account Lease	6,350	2012-2018
Cook Recapture Well	160	2015-2018
Total	**9,470**	

Additionally, the Program has secured 19,135 AFY of water via operational projects without an approved score (see below). These scores have been estimated by the Program's Executive Director's Office.

Project	Score [AFY]	Period of Operation
CPNRD Groundwater Recharge	600	2013-2018
Elwood Reservoir Recharge	2,800	2015-2018
CNPRD Surface Water Transfer	12,000	2015-2018
NPPD Groundwater Recharge	1,800	2015-2018
CNPPID Irrigator Lease	1,935	2016-2018
Total	**19,135**	

In total, the Program has an estimated 108,605 AFY of water via operational projects. These water supplies (as well as water supplies from future WAP projects) can generally be characterized as follows:

1. Lake McConaughy Environmental Account (EA). This water is from projects that place water into the Lake McConaughy EA, which is a controllable source and is the Program's largest tool to meet downstream flow objectives. Depending on the time of year and other factors, releases of several thousand cubic feet per second (cfs) can be made.
2. Other Controllable Projects (Other Controllable). This water is from projects that provide water to the critical habitat reach upon demand (e.g., by turning a nob, opening a gate, etc.), and the source can be turned on and turned off. Most of these projects provide controllable water at a significantly less rate than can be provided via the EA, generally in the 2 to 50 cfs range (per project).
3. Non-Controllable. This water is from projects that provide water to the critical habitat reach via an uncontrollable means (e.g., via groundwater recharge). These projects can be thought of as baseflow augmentation projects in that the water returns to the river but cannot be controlled in volume or time. Most of these projects provide water at a rate similar to the smaller Controllable projects, generally in the 2 to 5 cfs range (per project).

The Program has an estimated 90,545 AFY of EA water, 160 AFY of Other Controllable water and 17,900 AFY of Non-Controllable water (see below).

Project	**Score [AFY]**
Lake McConaughy Environmental Account	90,545
Other Controllable	160
Non-Controllable	17,900
Total	**108,605**

The remaining 11,395 AFY in annual reductions to target flow shortages to achieve 120,000 AFY in total annual reductions (or the remaining 21,395 AFY to achieve 130,000 AFY in total reductions) will be secured through additional WAP projects (see below). Two projects, the Cottonwood Ranch Broad-Scale Recharge Project and the Lakeside Slurry Wall Project are in the construction and final design phase, respectively, and have an estimated total score of approximately 6,800 AFY. The remaining projects are in the planning phase, conceptual design/feasibility phase or the preliminary design phase. It is important to note that cost estimates are still being developed but it is unlikely that the Program will be able to afford to implement all these projects. Projects not listed will also be evaluated as they present themselves.

Project	**Estimated Score [AF]**	**Phase**	**Water Supply Characterization**
Cottonwood Ranch Broad-Scale Recharge	4,000	Construction	Non-Controllable
Lakeside Slurry Wall	2,800	Final Design	Controllable
Groundwater Recapture	10,000	Prelim. Design	Controllable
NPPD Surface Water Lease	600	Planning	EA
CNPPID NCCW Lease	2,800	Planning	EA
North Platte Irrigation Lease	2,500	Planning	EA
Total	**22,700**		

Operationalizing Program Water Management

The Program has been actively pursuing the acquisition of water supplies to meet the First Increment Water Objective of reducing deficits to USFWS target flows by 130,000 to 150,0000 AF. As the Program enters the Extension, the Program strives to quickly achieve a reduction of 120,000 AF in USFWS target flows. As this goal is approached, the Program is focusing more on how to use the water in relation to its scientific objectives. Program water management coupled with scientific findings will help inform the testing of target flows and associated species benefits and conduct the science necessary to test the need for additional 10,000 AF.

In early 2018, the EDO conducted an internal scenario planning exercise. Four hypothetical futures were developed that represent a broad spectrum of what the future could be based on hydrologic conditions (e.g. wet vs. very dry years) and the degree of operational control the Program has in managing its supplies. Through this process, it was concluded that the Program will be most successful in meeting its scientific objectives with a water supply portfolio that enables a high degree of control on when, how much, and the duration of flows released to meet target flow shortages and other operational and scientific Program needs. Such control is easier to obtain through a few key large surface water storage projects than through many diffuse projects. This conclusion reoriented the WAP towards acquiring Program water that can be stored in the Lake McConaughy Environmental Account (EA), which is currently the only viable large storage vessel in the Central Platte Basin, and intensified its efforts to address the choke point.

From an operational perspective, the Program's water supplies may be characterized as the controllable Lake McConaughy EA, other controllable projects and non-controllable projects. These are described in further detail in the *PRRIP Water Update,* distributed with this document. The yields of these projects vary by hydrologic year, as shown in Table 1. The Lake McConaughy EA provides the greatest yield in all years while the controllable and non-controllable projects provide nearly equivalent yields contributing about 20% of the total yield.

Table 1: Estimated Program Project Yields (KAF)

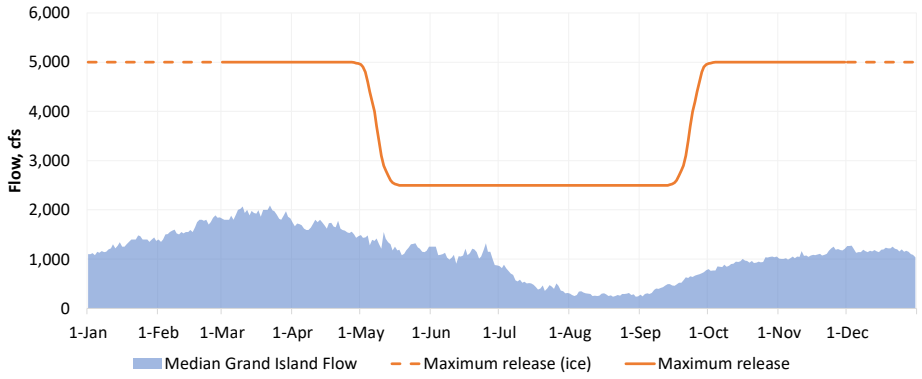
	Wet Years	Normal Years	Dry Years
Lake McConaughy EA	120	100	77
Controllable Projects (AHR)	13.5	12	11.5
Non-controllable Projects	14.5	13	10.5
Total	148	125	99

Note: These yields are estimates for discussion purposes. More in-depth analyses will be conducted at a later date.

While the Lake McConaughy EA is the Program's main tool in meeting downstream flow objectives, it is limited by physical flow capacity at the choke point and other operational constraints. Figure 1 shows the approximate maximum amount of releases that can be made by the Lake McConaughy EA during the following times of year:

- Irrigation season (mid-May to mid-Sept) – Releases are limited to about 2,500 cfs. This is the maximum physical conveyance capacity available through the choke point (assuming modifications are made) and NPPD's system after native flows, irrigation and power production releases.
- Shoulder season (Mar to mid-May and mid-Sept to Dec) – Releases are limited to about 5,000 cfs. This is the maximum physical capacity available through the choke point and NPPD's system after native flows and power production releases.
- Winter season (Dec to end of Feb) - Releases are limited to about 5,000 cfs, same as the shoulder season, however releases are limited to times when ice is not present in the channel. In warmer years, there will be longer periods available for releases than in colder years.

Figure 1: Lake McConaughy EA Seasonal Maximum Release Estimates



Note: These estimates assume that improvements have been made to the choke point, providing a total conveyance capacity of 5,000 cfs.

In addition to ice, there are times during the shoulder season and in the winter when there are facility outages due maintenance and releases cannot be made. Also, during dry years, reaches of the Platte River have historically been dry. During these dry periods, Lake McConaughy EA releases cannot reach the associated habitat reach (AHR) because of excessive losses from the river channel. Baseflows from non-controllable projects (recharge) and other controllable projects (gravel pit storage and retiming wells) closer to the AHR could prove to be key in providing flows through the AHR. While these flows would be significantly less than a Lake McConaughy EA release, they provide a degree of flexibility and opportunity to conduct experimental flows in dry periods. In wet years, Lake McConaughy could be of higher risk in reaching effective capacity where, if sufficient releases are not made, the Lake McConaughy EA could reset. Wetter years provide an opportunity for more flow releases, yet still must adhere to the operational and capacity constraints.

The hydrologic year influences the USFWS target flows and amount of water available in the Lake McConaughy EA. Figure 2 shows the operational range of release quantities and associated release duration before storage in the Lake McConaughy EA is exhausted for wet, normal and dry years. For instance, 2,000 cfs may be released in a normal year for approximately 22 days, however, after 22 days, all EA water would have been released. While the Lake McConaughy EA provides an ample amount of storage for the Program, it is a finite source of water and the Program is limited to the amount, duration and number of flow releases in a given year.

This discussion highlights the importance of strategically planning how the Program can efficiently utilize its Lake McConaughy EA, other controllable projects and non-controllable projects to meet its flow objectives. Operations can vary each year depending on the Program's specific annual flow objectives coupled with hydrologic conditions, and other operational and capacity constraints in the Basin. The capacity and operational constraints, benefits and trade-offs associated with integrating multiple Program water projects in a highly managed Basin needs to be well understood and daily operations must be coordinated with other Basin stakeholders to meet Program flow objectives.

Figure 2: Lake McConaughy EA Release Magnitudes and Duration